

Cadmium Aquatic Life Ambient Water Quality Criteria
Updated Briefing for Betsy Southerland
March 14, 2016

1. OVERVIEW

a. Criteria document revision based on comments received during 60 day public comment period

b. Comment letters received

- i. Florida Department of Environmental Protection
- ii. Illinois Environmental Protection Agency
- iii. Wisconsin Department of Natural Resources
- iv. Kansas Department of Health and Environment
- v. Utility Water Act Group (via Hunton and Williams)
- vi. Hampton Roads Sanitation District
- vii. US Geological Survey
- viii. National Marine Fisheries Service
- ix. Center for Biological Diversity
- x. California State Water Resources Control Board

c. Limited changes in document content occurred as a result of public comments

- i. Freshwater acute and chronic values decreased slightly
- ii. Estuarine/marine acute and chronic values decreased
- iii. Most other revisions involved addition of clarifying tables, figures, or text

	2016 Revised Values		FRN Draft Publication Values		2001 Criteria Update	
	Acute (1-hour, dissolved)	Chronic (4-day, dissolved)	Acute (1-hour, dissolved)	Chronic (4-day, dissolved)	Acute (1-day, dissolved)	Chronic (4-day, dissolved)
Freshwater (Total Hardness = 100 mg/L as CaCO ₃)	1.8 µg/L ^a	0.72 µg/L	2.1 µg/L ^a	0.73 µg/L	2.0 µg/L ^a	0.25 µg/L
Estuarine/marine	33 µg/L	7.9 µg/L	35 µg/L	8.3 µg/L	40 µg/L	8.8 µg/L

^a Lowered to protect the commercially and recreationally important rainbow trout, as per the

1985 Guidelines, Stephen et al. (1985).

d. Currently revising based on Agency Workgroup review

Action	Date
Agency Workgroup Draft Review	4/20/15 – 5/20/15
External Peer Draft Review	8/22/15-10/2/15
Agency Workgroup	11/2/15 – 11/10/15
60 Day Public Comment Period/Revisions	12/1/15 – 2/1/16
Agency Workgroup Review of Final Document	3/1/16 – 3/9/16
FRN Publication	3/30/16

2. KEY DOCUMENT CHANGES BASED ON PUBLIC COMMENT PERIOD

a. Freshwater acute value decreased from 2.1 ug/L to 1.8 ug/L dissolved

- i. Corrected hardness equation to remove all tests with unmeasured concentrations to ensure validity of results. Resulted in lower hardness slope, from 1.103 in 2015 draft to 0.9789 (which is closer to the Idaho 2006 slope).
- ii. Acute values were reviewed; the following data for salmonids were revised based on commenter input (USGS)
 - Rainbow trout
 - a. Removed insensitive smolt values from Chapman 1978 (>14.67 µg/L normalized)
 - b. Retained next highest value for swim-up fry from study (6.575 ug/L normalized)
 - c. Removed low values from Davies 1993 due to influence of high magnesium addition in high hardness test water (>400 mg/L H) yielding inaccurately low LC50s
 - d. Removed high outliers (LC50>12) of Hollis (1999, 200a) and Niyogi (2004) beyond 10-fold range of expected criteria, which were also suspect because are only rainbow trout data using cadmium nitrate salts (All other tests were with cadmium chloride or sulfate salts).
 - e. SMAV changed from 4.468 to ~3.720
 - Chinook salmon
 - a. Removed insensitive parr and smolt values from Chapman 1978 (17.70 ug/L and >14.67 ug/L normalized)
 - b. Retained next highest value for juveniles from study (6.504 ug/L normalized)
 - c. SMAV changed from 9.888 to 7.141

- b. Freshwater chronic value decreased from 0.73 ug/L to 0.72 ug/L dissolved**
 - i. Added in Cottus 21-day chronic test due to importance as sensitive result despite short test duration (USGS)
- c. Estuarine/marine acute value decreased from 35 ug/L to 33 ug/L dissolved**
 - i. Commenter (UWAG) noted *Neomysis integer* does not occur in North American waters
 - ii. *Neomysis integer* (65.25 ug/L normalized) was removed from database
 - iii. *Neomysis Americana* (28.14 ug/L normalized) was added to the database after obtaining an additional paper (Roberts et al. 1982)
- d. Estuarine/marine chronic value decreased from 8.3 ug/L to 7.9 ug/L dissolved**
 - i. Estuarine/marine chronic value was based on an removal and replacement of *Neomysis integer* with use of Acute-to-Chronic Ratio
- e. Notable editorial changes/clarifications**
 - i. Information was added clarifying approach and source of data for converting total to dissolved concentrations for fresh and saltwater including
 - Data sources
 - Water and salts used for testing: Natural surface waters and cadmium chloride and cadmium sulfate salts used for simulation
 - ii. Footnotes edited in Appendix A and B to differentiate “Data not used to calculate SMAV because more sensitive lifestage available” from “Flow-through measured test available”
 - iii. Table 5 was modified to identify specific genus used to fulfill each of the family MDRs, instead of only numbers of phyla, family, genera, and species used to derive criteria
 - iv. Additional tables were added identifying which studies and values were used in the acute and chronic hardness normalization analysis (Appendices A-2 and C-2)
 - v. Graphs were added showing the freshwater acute hardness linear regressions to better illustrate the normalization process (Figures 2 and 4)

3. KEY COMMENTS/RESPONSES WITH LIMITED OR NO REVISION

- a. Comment #1: Change in acute duration from 24 hours to 1 hour is not adequately justified or supported by new studies and may require additional samples to be collected (UWAG)**
 - i. Response**
 - A one hour duration is consistent with 1985 Guidelines:
“One hour is probably an appropriate averaging period because high concentrations of some materials can cause death in one to three

hours. Even when organisms do not die within the first hour or so, it is not known how many might have died due to delayed effects of this short of an exposure. Thus it is not appropriate to allow concentrations above the CMC to exist for as long as one hour.”

- One hour duration is consistent with all prior cadmium criteria revisions (1996, 1985, 1980), with the draft versions of the 2001 cadmium revision, and with all 45 of the other acute values except freshwater copper (which we are correcting)
- Changing the duration to one hour will not affect the expression of WQBELs; consistent with the NPDES regulations (40 CFR 122.45(d)) and WQBEL derivation procedures (EPA’s TSD guidance) WQBELs would continue to be expressed in terms of Maximum Daily and Average Monthly averaging periods

b. Comment #2: Concerns with the quality of the toxicity test conducted on the amphipod *Hyaella azteca* (Ingersoll and Kemble 2001); which is the most sensitive organism tested (IEPA)

i. Comment

- Criterion derivation should be repeated using newly developed feeding methodologies for *H. azteca* tests (Soucek, paper in press)
- Test organisms did not attain minimum growth requirements based on the direct measure of organism weight (average dw of controls = 0.27 mg/individual); EPA then used length data to extrapolate to dry weight with a regression equation but provided no supporting documentation

- **Response**

- a. Growth and reproduction are acceptable based on current guidelines

- i. Growth

- 1. Average control growth = 0.524 mg dw/individual after 42 days (indicated by the regression equation)
 - 2. ASTM (2005) requires ≥ 0.15 mg dw/individual
 - 3. Environment Canada (2013) requires ≥ 0.10 mg dw/individual)
 - 4. Mount and Hockett recommend ≥ 0.50 mg dw/individual (Appendix K)

- ii. Reproduction

- 1. Average control reproduction = 6.4 young/female after 42 days
 - 2. ASTM (2005) requires > 2 young/female
 - 3. Mount and Hockett recommend ≥ 6 young/female (Appendix K).

- b. Ingersoll indicated direct weight measures were unreliable at the time study was conducted (scale accuracy); length measures

were accurate and regression equation used to determine weight from length has been used in multiple peer-reviewed publications and will be in forthcoming ASTM guidance

ii. Comment 2b

- Dilution series tested (control, 0.1, 0.3, 0.5, 2.0 and 3.0 µg/L.) did not appropriately bracket the effect concentration; a large gap in test concentration between the NOEC and LOEC (0.5 and 2.0 µg/L, respectively) led to an imprecise EC20
- **Response**
 - a. Graph of response curve data indicates a break close to the 2.0 ug/L treatment concentration, and sensitivity analysis suggests additional concentration would not have appreciable effect on calculated EC20

c. Comment #3: Clarify if states have the option to adopt total Cd criteria values (FDEP, WDNR)

i. Response

- Both dissolved and total concentrations are presented for use by states
- EPA recommends the use of dissolved concentration, whenever possible, since it better represents bioavailable fraction

d. Comment #4: Criteria Must Be Fully Protective of ESA Species (NMFS, CBD, CSWRCB)

i. Comment 4a

- EPA must consult the Services in its criteria recommendations
- **Response**
 - a. EPA intends to consult with the Services when undertaking the Federal action of approving cadmium criteria submitted by the states for EPA's consideration
 - b. EPA is conducting an analysis of salmonids for the Oregon Toxics evaluation, consistent with the Reasonable and Prudent Alternatives contained in the NMFS opinion, on the updated 2016 acute cadmium criterion magnitude relative to salmonid species of concern in Oregon. EPA notes that available salmonid "curve-fitted data" indicate that the lowest mean minimal salmonid effect level specified by NMFS in the opinion (5%) occurs at concentrations slightly higher than the national acute criterion recommendation or water quality standard based on this recommendation. EPA also notes that additional protection is expected because the acute criterion duration is specified to be a one-hour duration, and the frequency recommendation is that the one-hour concentration not be exceeded more than once in 3 years on average.

ii. Comment 4b

- It needs to be determined if cadmium accumulation from US waters over a lifespan would reach tissue concentrations resulting in adverse effects, particularly in long lived species and/or species ingesting sediment.
 - a. Long-lived omnivorous sea turtle species (i.e., leatherback, loggerhead)
 - b. Long-lived species that ingest sediment on smalltooth sawfish and Atlantic, Gulf, or shortnose sturgeon species
- **Response**
 - a. Data on estuarine/marine species, particularly chronic data and data for longer-lived species are extremely limited, but cadmium is unlikely to accumulate to levels that would result in adverse effects
 - b. Most aquatic organisms are considered to be more susceptible to cadmium from direct aqueous exposure than through bioaccumulation; criteria protective of direct exposure effects are considered more applicable to the development of criteria for aquatic life